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## EUROPEAN PATENT APPLICATION

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(54) A method for washing clothing in a domestic washingmachine

(57) A method for washing clothing in a domestic washing machine" wherein, following loading of the clothing and addition of the water in the tub, of reduced volume, the drum rotation is activated according to a cyclic sequence (6) of time intervals in each direction of rotation and with a stop for each reversal, this sequence

also being valid in the subsequent rinsing stage, said intervals (6b, 6c) being made up of times ( $t_1$ ,  $t_2$ ,  $t_3$ ) of short duration, at stepped speeds ( $N_1$ ,  $N_2$ ,  $N_3$ ) which are low for soaking, medium for washing and high for spinning, two speeds ( $N_1$ ,  $N_2$ ) succeeding each other in some intervals and, in others, the three speeds.

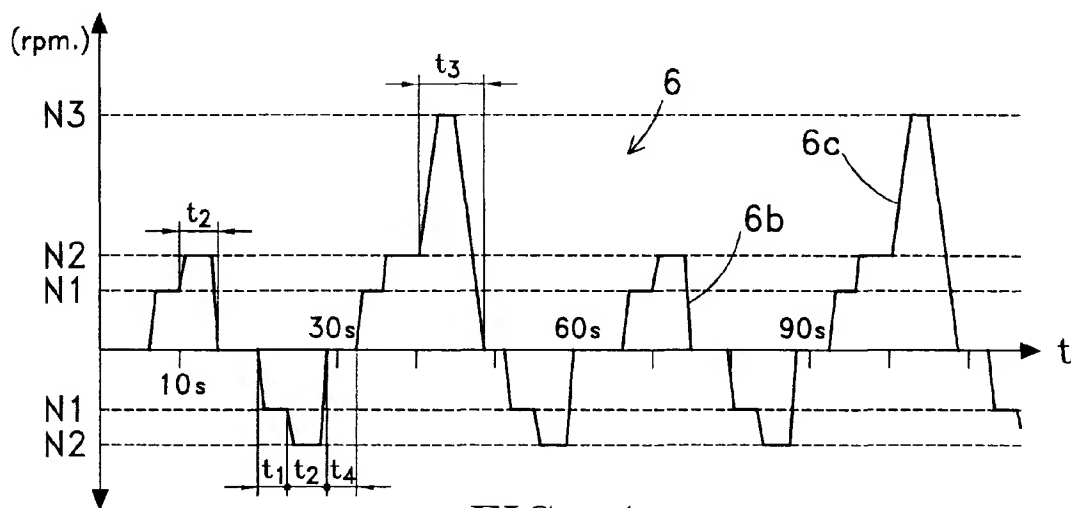


FIG. 1

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## Description

### TECHNICAL FIELD OF THE INVENTION

The present invention relates to a whashing method programmed in a domestic washing machine and more specifically to a cyclic sequence of rotation of the drum in relation to the clothing load and to the supplying and heating the water for washing.

### STATE OF THE ART

It is known in the field of domestic washing machines that the final result of the wash and the consumption of water and electricity for heating the water depends not only on the amount of clothing placed in the drum but also on the combination of speeds of rotation of the drum during the clothing washing and rinsing stages. Alternating rotation intervals in each direction succeed each other, with a stop time for each reversal of the direction of rotation, a preliminary 'soaking' time for the clothing in each rotation interval of low-speed rotation of the drum between 30 and 40 r/min, and alternating without an intermediate stop, with the usual medium speed of wash such as 45 to 70 r/min, allowing better use of the process time and a reduced volume of water wasted.

On the other hand, the soaking of the clothing is improved as is the mixing or fluctuation of the clothing, with the cooperation of hollow drag ribs secured onto the inside wall of the drum, which move the clothing and discharge the water on to the clothing from above which they scoop up as they move through the bottom of the tub and then rise to a certain angle against said bottom. The water level over the bottom of the tub must reach the rim of the drum so that said drag ribs can fill with water as they pass through the drum.

The rotation intervals of the drum at stepped speed values follow each other in short periods of duration, i. e. several seconds, alternating between the two rotation directions. The cyclic sequence repeats through the process time, which may be up to two hours. Nevertheless, despite of combining the whsing process with a time interval at the low- speed in order to facilitate the cloths soaking, in the case that the drum was loaded in a way to the full, an uneven soaking results during the washing and this process last longer than that in the case the drum is not completely loaded.

It is also known that the life time of a washing machine, due to the vibration, also depends fundamentally on the number of switching operations or startups of the drum spinning.

GB-2145119 combines intervals of 3 and 9 seconds which consist of two stepped speed values, low and medium, without interruption, in both directions of rotation, with the drum stopping for 2 seconds for each inversion of the rotation. This sequence is repeated a number of times until the total processing time is completed.

In washers provided with electronic speed control it is also possible to rotate the drum at a third speed, as high as that for spinning, within the sequence of intervals of stepped speed values, in order to facilitate the introduction of the detergent into the fabric and to exchange the water on the interior clothing layer with the peripheral layer.

In EP-0159204, the speed values sequence includes a short duration interval at a spin speed of 500 r/min between two low-speed short intervals, to facilitate the exchange of water between the interior and peripheral layers of clothing in the drum, and the water level is 3% of the drum diameter. This known method is only carried out in a previous soaking stage prior to the washing stage, thus a drawback of no sufficient soaking arises during the following washing stage because it is not kept as initially. A second drawback in this method is due to the fact that at the medium speed for washing the wetting for soaking it is not achieved quick enough, and if a spinning interval is inserted an excessive foam generation takes place, the spinning speed interval when superposed to the single medium speed being as a consequence self-defeating for washing.

### DISCLOSURE OF THE INVENTION.

Is the object of the invention a method for washing clothing in a domestic washing machine provided with a electronic speed control, alternately inverting the rotation of the drum, and with devices for controlling the volume of water supplied to the tub and the water heating temperature, to obtain an efficient result in cleaning the clothing with different loads in different washing programs for each clothing textile and, in all such programs, to obtain a reduction in the water consumption, detergent and electricity, by reducing the heating time, the water level in the tub and the preset value of water temperature, while preventing the washing machine from an excessive number of startups of the drum at a spinning speed, by means of a cyclic sequence of short intervals of the drum rotation at stepped low and medium speed values, inserting said time intervals rotation stops, and the addition in only some of them without interruption a spinning step at moderate high speed and in only one of the rotation directions, and as a result of the short duration at moderate spinning speed value, avoiding an excess of foam generated by the wash detergent, which in addition prejudices the drumming among the clothing pieces.

The inserted high speed rotation interval causes during the washing stage the interchange of the water wetting the clothing with the water remaining in the tub, the latter being that is warmed by the heaters, and this effect facilitates the regular warming of the water wetting the clothing.

The method object of the invention has another advantage over the known methods when it is carried out in a drum tightly filled with clothing, such as more than

1 Kg of dry clothing each liter of the drum capacity, since the centrifugal force during the spinning speed interval causes the crashing of clothing against the drum wall, and then clothing pieces are rearranged in a different way when they are stirred up by the drag ribs, and thus going faster and more evenly the soaking during the whole washing stage.

The spinning step added into some of the rotation intervals during the wash and rinse stages leads to the problem of vibration of the drum if the clothing load is unbalanced so that, prior to acceleration from average to high speed, an imbalance test is programmed with the electronic control unit, preventing the spinning high speed in intervals where such imbalance is detected.

The method object of the invention comprises the following steps:

- loading the drum of the washing-machine with a given amount of clothing, amounting to a full load or a half load;
- supplying a volume of water and soap which soaks the clothing and reaches a level in the tub to the periphery of the drum, followed by connecting the water heating, to a preset temperature value;
- rotating the drum for the washing stage, according to a cyclic sequence of short-duration running intervals alternating in both directions, with the succession of two different intervals, one such interval consists of an uninterrupted succession of two rotation values, of low and of high speed, in that order, while the other consist of three stepped speeds, without interruption, low, medium and high speeds, in that order, said three-speed interval being executed in only one of the rotation directions, and in a less quantity than the two-speed rotation interval is done;
- draining the washing water for following the rinsing stage and supplying a reduced volume of clean water, which is replaced a number of times, the rotation of the motor being provided with the same cyclic sequence of speeds and times as in the previous washing stage.

#### DESCRIPTION OF THE DRAWINGS

FIGURE 1 is the time-speed diagram for rotating of the drum during the different stages of the wash and the rinse object of the invention, for programs with a full clothing load. FIGURE 2 is the diagram in figure 1, adapted for half-load programs.

FIGURE 3 is a partial representation of the clothing load into the drum and the water level in the washing-machine tub.

FIGURE 4 shows each of the cyclic intervals in figure 1, from the top down showing a programmed interval in the washing-machine control unit; an interval selected for very delicate wash programs; an interval selected for delicate wash programs; and an interval selected for

normal wash programs.

#### PREFERRED EMBODIMENT OF THE INVENTION

With reference to Figures 1 - 4, the embodiment of the method object of the invention for the stages of washing and rinsing the clothing 1 in a washing machine 2, 3, 4 comprises, following the loading of the clothing 1 as shown in figure 3, supplying of a single take-off for the entire washing stage of a volume  $V$  of water in the tub 2, of approximately 14 litres, to a level 5 which just covers the bottom of the rotary drum 3 and including the clothing 1, which seems as being distributed inside the drum 3 in three layers peripheral, intermediate and interior.

The clothing load in the drum 3 may be full, e.g. 5 kg, that means tightly filled, or a half-load, of 2.5 kg, and the intake volume  $V$  of water 12 litres. The method in the invention requires the wall of the drum to have three or four hollow drag ribs 4 which furthers provide collecting the water from the tub as they move through it, through their external openings 4a, then letting it spray after they have moved more than 30° onto the clothing to better soak the internal layer.

Depending on the capacity of said clothing drag and water spray ribs, the cyclic sequence 6 of rotation speed  $N$  as a function of time will include more or less intervals at high speed  $N_3$ , i.e. quicker soaking will allow in turn a more frequent release of water from the clothing, with the inclusion of a larger number of intervals at speed  $N_3$ .

When the programmed water level 5 is reached, with the addition of detergent, the water heating comes on, up to a temperature of between 30 °C and 90° C, thermostatically controlled.

Simultaneously to the heating for the washing stage, the motor is activated to rotate the drum 3 in a cyclic sequence 6 of rotation intervals 6b or 6c alternating in both directions, separated by a stop time  $t_4$  in each reversal of direction.

The normal wash programs run one of the two cyclic sequences 6 shown in figures 1 and 2, depending on the other factors affecting soaking, such as the efficiency of the drag ribs 4 and the clothing load, both sequences being differentiated in that the high speed  $N_3$ , e.g. of 300 r/min, is connected respectively twice in each 2.5 minute period, or only once, its duration  $t_3$  being four or five seconds, including acceleration, the time at maximum speed being limited to a less than five seconds to prevent formation of detergent foam.

A high speed value  $N_3$  of 400 r/min may be used but, in this case, to limit the formation of detergent foam, time  $t_3$  must be shorter or, otherwise, these intervals containing said high speed  $N_3$  must be less frequent.

Intervals 6b and 6c also shown in Figure 4 alternate in one of the rotation directions while in the reverse direction only interval 6b is connected, of stepped speeds, i.e. low speed  $N_1$  for soaking, at approximately 35 r/min for a time  $t_1$  of three or four seconds, and the medium

speed N2 for washing, at approximately 55 r/min, for a time t2 i. e. between five and eight seconds, always including acceleration time.

The three speeds N1, N2 and N3 must run in that order: with the first, N1, the clothing is soaked, the second, N2 facilitates fluctuation of the clothing 1 and penetration of the detergent into the fabrics while, with speed three, N3, the water in the clothing is exchanged with that in the tub 2, helping the water to heat evenly in the three layers of clothing referred to, and a shorter heating time up to the graduated temperature, providing a total time saving in the process, between wash and rinse, of 10% i.e. approximately 10 minutes, in water consumption of 2 litres and in power consumption of 20% in comparison with unvarying N2 speed sequences.

With reference to figure 4, in delicate wash programs where there is only a half load, only interval 6b is used while for very delicate washes, where there is only a 1 kg load, interval 6a is used, at a single rotation speed of N1.

At the end of the washing stage, the rinse stage is carried out to remove detergent and dirty water, with the same cyclic intervals sequence 6 as is carried out in the washing phase. During the rinse phase, there are a total of four water intakes, of a volume of 14 litres each, with savings in water consumption of up to 2 litres per intake.

For the selection in each wash program for different clothing textiles, of the cyclic sequence 6 of time intervals t1, t2 and t3 at different speeds, the programming of the electronic control unit has a single succession recorded (6p) of speed values N1, N2 and N3 in fixed times t1, t2 and t5 of which times t1 and t2, at low speed N1 and medium speed N2, are the same as those used to run the cyclic sequence 6, but the last time, t5, at high speed N3, extends beyond the value t3 for the running time, and the different intervals 6a, 6b and 6c being executed by switching off the drum rotation at changeable predetermined times t.

Before accelerating from medium speed N2 to high speed N3, the control unit performs the imbalance test on the drum load, measuring the variation in the current consumed by the drum drive motor during the rotation, or using some other known electronic procedure, and cutting said acceleration out if an imbalance is detected.

N2,N3) stepped in time intervals (t1,t2,t3) of short duration without interruption between them, characterized in that

- said cyclic sequence (6) is run in either wash and rinse stages, has two different rotation intervals (6b,6c), one (6b) of which consisting of a succession of two speeds (N1,N2), which are a low speed (N1) for soaking, and a medium speed (N2) for washing, in that order and without interruption between them, while the other rotation interval (6c) consists of a succession of three speeds (N1,N2,N3), said low speed (N1), said medium speed (N2) and a moderate high speed (N3) for spinning, in that order and without interruption between them.
- 2. A method for washing clothing as set forth in claim 1, wherein said rotation interval (6c) consisting of three stepped speeds (N1,N2,N3) is executed in only one direction of rotation, and in a smaller quantity than the two-speed rotation interval (6b) and, prior to acceleration to the moderate high speed (N3), the electronic control unit carries out an imbalance test on the loaded drum.
- 3. A method for washing clothing as set forth in claim 1, wherein the duration of the time intervals (t1,t2,t3) of each speed within a single interval (6b,6c) is of several seconds, including the acceleration, the soaking time (t1) is shorter than the other two, (t2,t3), and the wash time (t2) is longer than the other two (t1,t3).
- 4. A method for washing clothing as set forth in claim 1, wherein the three values (N1,N2,N3) of speed of the rotation interval (6c) are approximately 35 r/min and 55 r/min the first two, and 300 to 400 r/min the last.
- 5. A method for washing clothing as set forth in claim 1 wherein, for selection in each wash program of the cyclic sequence (6), the programming unit has a single succession registered (6p) of values for speeds (N1,N2,N3) in their respective fixed times (t1,t2,t5).

## Claims

1. A method for washing clothing in a domestic washing-machine (2, 3, 4) for the wash and rinse stages, the washing -machine having drag ribs (4) on the internal periphery of the drum (3) where, once the clothing (1) is loaded and the heating is on for the water in the machine tub (2), the drum rotation comes on according to a cyclic sequence (6) of rotation intervals (6b, 6c) in both directions, each consisting of a combination of at least two speeds (N1,

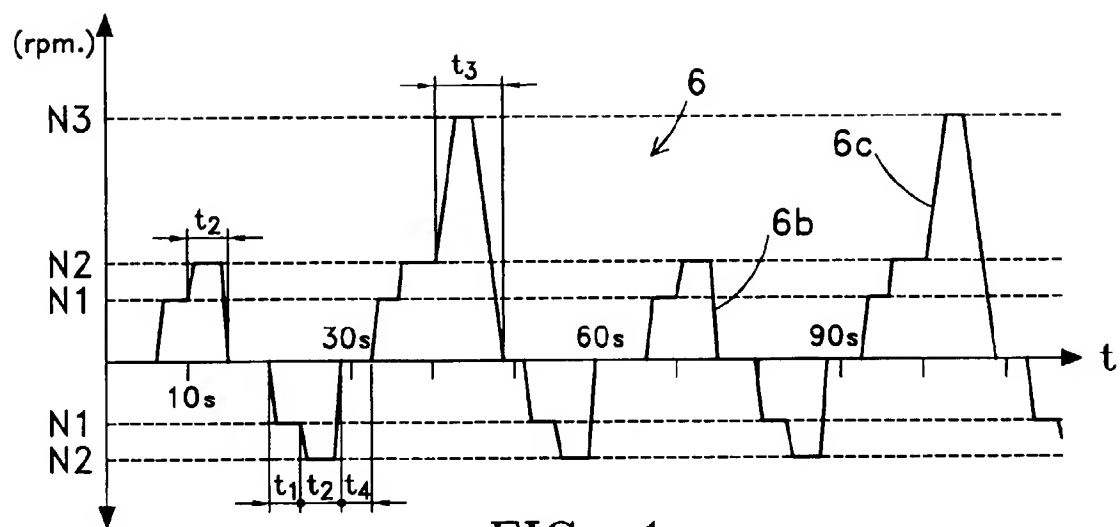


FIG. 1

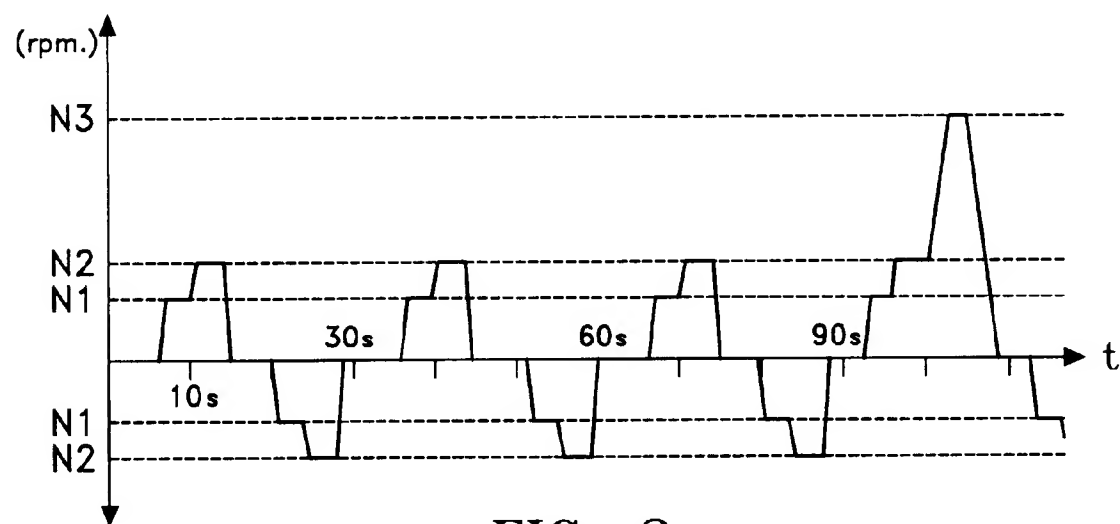


FIG. 2

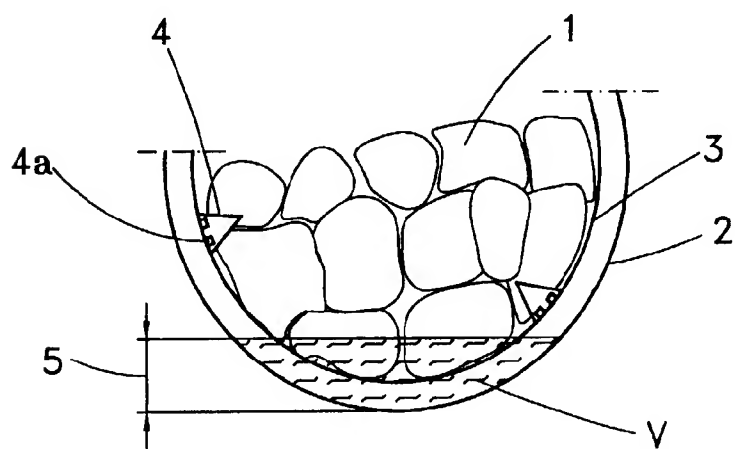


FIG. 3

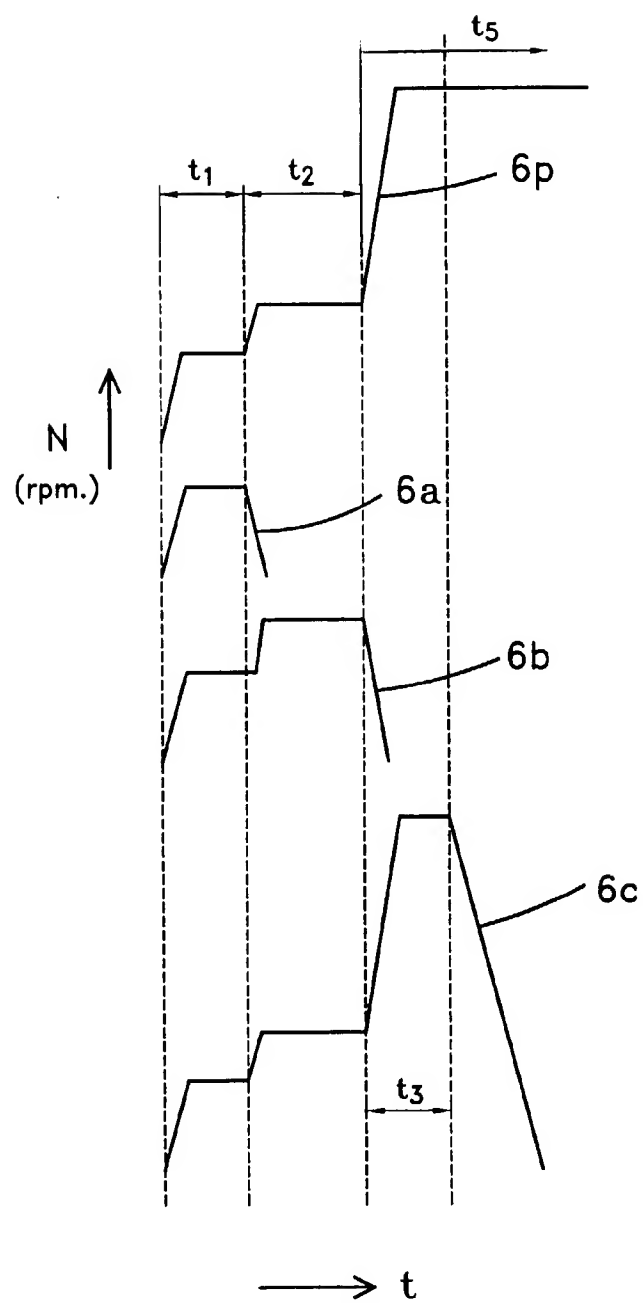


FIG. 4



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# EUROPEAN SEARCH REPORT

Application Number  
EP 96 50 0154

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	GB 2 145 119 A (MIELE & CIE GMBH) * page 1, line 108 - page 2, line 4; figure 2 *	1	D06F35/00
A	--- EP 0 369 933 A (MIELE & CIE GMBH) * claims; figure *	1	
A	--- EP 0 618 323 A (BOSCH-SIEMENS HAUSGERÄTE GMBH) * claims; figure *	1	
A,D	--- EP 0 159 204 A (ESSWEIN S.A.) * page 5, line 31 - page 6, line 22; figure 5 *	1	
A	--- EP 0 629 733 A (ZANUSSI ELETTRODOMESTICI S.P.A.) * claims; figure * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			D06F
Place of search		Date of completion of the search	Examiner
THE HAGUE		2 April 1997	Courrier, G
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